For Angeles: Williams ST-12 Concerns leading to 6/7/16 AF letter

Summary: After several years of very amicable cooperative working relationship, we have reached a point of significant technical disagreement with Amec, the PBR contractor for ST12 Fuels Spill site. The Steam Enhanced Extraction (SEE) system they constructed and operated with TerraTherm represents the world's largest application of this technology to date; the more than 2.5 million lbs of petroleum hydrocarbons removed from the site represents half of the total mass of contaminants SEE vendor TerraTherm has removed in their entire history of operation. The SEE has been a huge success.

Technical Issues: Unfortunately, the site was not well characterized to begin with, and there is significantly more mass remaining at the site than what even the SEE system was designed to handle. We believe Amec terminated the SEE system prematurely, while they were still removing thousands of pounds of hydrocarbons per day, and before all of the shutdown criteria we had established in the workplan had been attained. Terratherm told us that Amec asked them for an estimate to complete the SEE to remove the remaining NAPL, which would have added $6 million to the cost and Amec turned them down. With only 3 years remaining in their PBR contract, Amec is now proceeding to employ enhanced bioremediation (EBR) to address the remaining LNAPL, without quantifying the remaining mass. We are concerned that if they do not know the mass of NAPL remaining, how would they know how much amendment would ultimately be required? How would they be able to evaluate success of the application if the initial baseline conditions are unknown? The sodium sulfate amendment they are planning to use, mined from a natural deposit, contains arsenic, which could worsen groundwater conditions by creating a new arsenic plume, greatly increase the salinity, and also produce significant hydrogen sulfide gas that could be a health hazard around the wells. Further, the agencies are concerned that the termination of the extraction system will allow the contaminants to spread, which was not an intention in the 2012 RODA. Enhanced Bioremediation was intended to degrade residual contamination; is appropriate for degrading hydrocarbons dissolved in water, but not an appropriate technology to address large quantities of LNAPL. Amec's attempt to apply EBR for this purpose represents an unintended reinterpretation of the 2012 RODA and represents a fundamental change to the remedy for the site. Amec's current actions represent an exit strategy from their contract, but does not set the AF up for successful long term management of the site.

Administrative Issues:

- The AFs letter indicating I was being hostile with Amec during the May 19 BCT call is a mischaracterization. This conversation came after many months of discussion where we were unable to get them to take our concerns seriously. What Amec is proposing to do, and the way they proceeding is risky for the environment, and could be ultimately risky for them as well from a business standpoint. I do not believe what I said to them was out of line. While EPA has never pursued action

against a contractor before, I do not think we can automatically assure them they would be indemnified if they are acting outside the scope of their contract, outside of regulatory approval, and they create a new environmental problem as a result of their actions.

- It was our understanding from what we were told from the previous AF BEC at the time of PBR contract award, that AF expected the contractor to obtain regulatory approval at each phase of the project as a performance measure specified in their contract. However, the way the contract has been operated, Amec has been working well in advance of any opportunity provided to the agencies to approve their workplans, with field work being completed before the workplans are finalized. We were shocked by Amec's statements to us during the March 15 BCT meeting in Phoenix that under their contract the regulatory agencies had only limited opportunity to affect changes to their workplans, specifically: 1) prior to initiation of the remedy and 2) at the closeout of the contract.

- The AF BEC admitted that she does not understand the technical issues, and she alone is in position to give technical direction. She relies heavily on her other contractor for technical advice and to speak on her behalf. His contract had ended early last fall and he was not present for any of the discussions regarding the SEE shutdown, while his contract was being renewed; he only recently came back on board.

- To be fair to Cathy, the technical details of the SEE system operation are very complex, the technology is still new and uncommon, and there are at present only a handful of technical experts in the country familiar enough with the technology to comment on the operations, and most of them are in the room during our technical discussions on this project. The technical discussions are pretty elevated, and Cathy's technical consultant was not contributing to the discussion when he was present.

Detailed Discussion:

Recent Chronology of events:

- Amec terminated steam injection at ST12 on March 4, 2016, while they were still removing thousands of pounds of hydrocarbons per day.
- On March 7, 2016 EPA and ADEQ notified AF that both agencies considered the shutdown of the SEE system to be premature and requested they continue.
- During the March 15 BCT meeting, Amec responded to agency concerns with statements that under their contract the regulatory agencies had only limited opportunity to effect changes to their workplans 1) prior to initiation of steam, and 2) at the closeout of the contract.

- After only 8 weeks of post steam extraction Amec terminated the extraction system on April 29, 2016 and began dismantling the SEE infrastructure to proceed with the EBR phase, while the EBR workplan was still in agency review.
- On May 3 EPA and ADEQ sent AF a joint agency letter disapproving termination of the extraction system, citing concerns for the potential of the plume to spread, given that SEE was not run to completion, they still needed to contain the plume.
- AF responded with a letter that Amec would not be able to continue the extraction system for various reasons but would proceed with site characterization as stated in the workplan, and requested that the agencies "support the remedy". Nothing in the AF's letter resolved the technical concerns that we had raised.
- In the April 21 BCT call Amec clarified that their characterization was not intended to evaluate the completion of SEE or to quantify the LNAPL mass remaining behind, but to confirm their conceptual approach for proceeding with EBR. However, our May 3 letter had attracted the attention of Amec attorneys who were present at the May BCT meeting in which I reminded Amec that this was a CERCLA site and their potential for future liability could extend beyond their period of performance if they are acting without approval and their actions worsened site conditions. I did not relay this in a hostile manner as suggested in the letter, but as a reminder of how serious our concerns were about their proposed work plan and they were taking a risk. However, Amec may have perceived it to be hostile with their attorneys were sitting in the room and likely created some internal turmoil at Amec. AF sent the 6/7/16 letter to calm Amec down and assure them that they would be indemnified as contractors.

Summary of Major Technical Concerns with Amec's proposal:

1) The 2012 RODA we signed selected Steam Enhanced Extraction (SEE) to remove as much of the LNAPL as possible and Enhanced Bioremediation as a finishing step. The termination of SEE while LNAPL was still being recovered left significant LNAPL in the ground, which Amec now intends to address using EBR. This represents a fundamental change to the remedy that was selected in the ROD, and an application that was not intended when we signed the ROD. At a minimum, it should warrant an ESD if not another ROD amendment.

2) Enhanced bioremediation is appropriate for degrading dissolved constituents, and not appropriate for attempting to degrade massive quantities of LNAPL that still remain at the site.

3) The 2012 RODA specified the remedy to achieve RAO of below benzene MCL within 20 years. In examining AF's model, it appears that they may be relying on advection and dispersion of the plume at least as much and biodegradation to achieve remedial goals, which is clearly outside the intention of the remedy set forth in the RODA. The plume needs to be contained and not allowed to spread.

4) Amec has not quantified the remaining LNAPL mass and has indicated that they do not plan to do so. The characterization they are preforming now is to confirm their conceptual model for the EBR application. But without quantifying the remaining mass, they cannot quantify how much amendment will ultimately be needed. They intend to just start injecting the amendment and monitor, and continue additional injections until their remaining 3 year contract term is ended, and they have no plans beyond that once they prepare a closure report. It is not clear how the monitoring data would be used to evaluate performance going forward without having clearly established baseline conditions.

5) The Sodium Sulfate amendment that Amec is proposing to use to biodegrade the remaining LNAPL is mined from a deposit that contains naturally occurring arsenic at 3 mg/kg. The injection solution is anticipated to have an arsenic concentration 100 times the MCL. It is unclear if this is permissible under state law.

6) In addition to creating a brand new arsenic plume that would not degrade in the midst of the hydrocarbon plume, the injection of 840 tons of sodium sulfate specified for the initial phase will likely greatly increase the salinity, and react with iron in the water to form hydrogen sulfide gas which could create a public health concern around wells.